

PROGRESS OF THEORETICAL PHYSICS

Founded by H. Yukawa in 1946

Advisory Council

K. HUSIMI, <i>Nagoya</i>	M. KOBAYASI, <i>Kyoto</i>
M. KOTANI, <i>Osaka</i>	T. MUTO, <i>Tokyo</i>
T. NAGAMIYA, <i>Osaka</i>	S. SAKATA, <i>Nagoya</i>
M. TAKETANI, <i>Tokyo</i>	S. TOMONAGA, <i>Tokyo</i>

Editor

H. YUKAWA, *Kyoto*

Volume 39

JANUARY—~~JUNE~~ MARCH

1968

Published for the
Research Institute for Fundamental Physics
and
The Physical Society of Japan

CONTENTS

No. 1 January

Time-Dependent Ising Model with Long Range Interaction	
..... Kyozi Kawasaki and Tomoji Yamada	1
Sound Attenuation in the Critical Gases	Yutaka Fukuyama 26
Theory of Multiple Scattering of Slow Neutron	
..... Takeo Nishigori, Shuichiro Yamasaki and Sigenobu Sunakawa	37
Boson Approximation of Nucleon Pairs in Even-Even Nuclei	
..... Koji Taruishi	53
Single Nucleon Transfer Reaction between Complex Nuclei	
..... Takehiko Suzuki	83
Potential Models of Nuclear Forces at Small Distances ..	Ryozo Tamagaki 91
Effect of Hidden Channels on Low-Lying Channels	
..... Kisei Kinoshita, Yukiko Kinoshita and Nobuyuki Murai	108
Low Energy Behavior of the π-π Phase Shifts	Haruichi Yabuki 118
S-Wave $\pi\pi$ Scattering with Small Scattering Lengths	
..... Yasunori Fujii and Koichi Hayashi	126
Saturation of Superconvergence Relations for Meson-Baryon Scatter-	
ing	Osamu Miyamura and Fujio Takagi 132
Scattering Lengths for Complex Angular Momenta	
..... Masakuni Ida and Haruichi Yabuki	151
Bootstrap Conditions in S-Matrix Theory	
..... Seiya Aramaki, Seiji Fukuzumi and Masatosi Ito	166
Exchange Current and Decays of Decuplet Baryons in the Quark	
Model	Tsunehiro Kobayashi and Kimiaki Konno 182
Vector and Axial Vector Mesons and Chiral Current Algebra	
..... Takanori Shiozaki	189
Phenomenological Dynamics of Strong Interaction with Partial	
Chiral Symmetry	Takanori Shiozaki 195
Deformable Sphere Model of Elementary Particles and Its Relation	
to Quark ..	Osamu Hara, Tetsuo Gotô, S.Y. Tsai and Haruichi Yabuki 203
Letters to the Editor:	
A Theoretical Foundation for Hofstadter-Wilson Formula	T. Narita 228
On the Classification of Higher Boson Resonances	K. Okada 230
Vector Coupling Constant in Nuclear Beta Decay	C. P. Bhalla 231
Mixing Ratio of the $M1$ and $E2$ Radiations in the $2^+ \rightarrow 2_1^+$ Transitions in Hg^{200}	
..... Y. Futami and M. Sakai	233
Stellar Accretion and X-Ray Source	S. Sakashita 235
Energy Flow in Harmonic Linear Chain	H. Nakazawa 236

Possible Excitation of High-Frequency Waves by a Large Amplitude Low-Frequency Wave in a Plasma	K. Nishikawa and T. Tanaka	238
Leptonic Decay of the Pion and the Spectral Function Sum Rules	S. Iwao	239

Errata

General Solution for the Modified Bogoliubov Functional in Non-Equilibrium Statistical Mechanics (Vol. 36, p. 420)	I. Hosokawa	242
A Possibility of "Complex Unitary Spins" and an Extended Particle Model (Vol. 38, p. 1411)	S. Hamamoto and S. Tanaka	243

No. 2 February

Ultrasonic Attenuation in Imperfect Insulating Crystals	B. D. Silverman	245
Spin Flip Scattering of Conduction Electrons from Impurities	K. S. Viswanathan and A. K. Rajagopal	270
Anomalous Spin Relaxation near the Magnetic Transition	Kyozi Kawasaki	285
Ferromagnetism of Itinerant Electrons with Strong Correlations	Akio Sakurai	312
Theory of Nonlinear Susceptibility —A Diagrammatic Approach—	Tatuo Kawasaki	331
A Theory of the Second Order Phase Transitions in Spin Systems. III —Critical Behavior of Correlation Functions in Ising Ferromagnets—	Masuo Suzuki	349
Homogeneous Cosmological Models without Shear	S. Banerji	365
The Frenkel-Kramers Model and the Zitterbewegung in the Extended Heisenberg Picture of the Dirac Electron	Hisaiti Yamasaki	372
Analysis of $\pi^+p \rightarrow \pi^0 N^{*++}$ Reaction by Regge Pole Model	Atsuko Iwaki	394
Chiral Dynamics for Photo-Hadron and Weak Interactions	Syurei Iwao	405
On the Non-Leptonic Decay Process	Takemi Hayashi, Shuzo Ogawa, Hisaichiro Okonogi and Minoru Yonezawa	411
The Effect of Channel Coupling on the Real Phase Shift	Susumu Furuichi and Haruo Suzuki	420
An Impact Parameter Representation of the Scattering Problem	Toshimi Adachi and Tsuneyuki Kotani	430
On the Normalization of the Bethe-Salpeter Wave Function in the Unequal-Mass Case by Means of the Stereographic Projection Method	Kenji Seto	453
Homological Study of the Generalized Singular Functions. II — Källén Functions and Their Analyticity Properties—	Masatsugu Minami	460

Svensson Representation with Local Commutativity	Masatsugu Minami	484
Gauge Theories of Massive and Massless Tensor Fields	Kenji Hayashi	494
A Theory of Anomalous Gravitational Interaction. III — <i>Breakdown</i> of the <i>Bianchi Identities</i> —	Yasuo Ezawa and Toshiei Kimura	516

Letters to the Editor:

Masses of Bosons with Spin One Unit and the Algebra of Fields	S. Iwao	526
The Experimental Test of the $SU(3)$ Symmetry in the High Energy Two-Body Reactions	K. Fujimura, T. Kobayashi and I. Ohba	528
The Real to Imaginary Ratio of the Forward Scattering Amplitude in Charge Exchange Processes	K. Fujimura, T. Kobayashi and I. Ohba	530
Conspiracy Relation for the Reaction $NN \rightarrow YY$	K. Morita	531
Effect of the Potential Scattering on the Low-Temperature Anomalies due to the s - d Interaction	Y. Nagaoka	533
Phenomenological Description of Energy Levels of Medium-Heavy Nuclei	P. C. Sood	535
Cluster Model of Mesons and Square Mass Relation	F. Toyoda	537
On Baryon Octets and $N_{1/2}^*$ (1400)	D. Kiang and R. Sugano	538
Morse Potential Mediation of Offshell 1S_0 Proton-Proton Scattering	J. E. Brolley and L. K. Morrison	540
On the Anomalous Dispersion in Second Sound of Liquid He II	M. Ichiyanaagi	541
Sounds in Liquid He II	M. Ichiyanaagi	543

No. 3 March

Unified Approach to Non-Ohmic Conduction in Piezoelectric Semiconductors	Ki-ichi Nakamura and Jiro Yamashita	545
Statistical Model for Vibrational-Rotational Population Distribution of Diatomic Molecule in Splitting of Four-Atomic Complex into Three Pieces	Sigeru Watanabe, Takashi Kasuga and Tadao Horie	564
Nonlinear Effects on Critical Fluctuations	Yoshiki Kuramoto	578
Lattice Vibration of a Linear Chain with Long-Range Interaction	Kazushige Ishii	593
On the Spectral Shift of Light Rays Emitted from a Pulsating Object	Hidekazu Nariai, Kenji Tomita and Mizuaki Hayakawa	601
Evolution of Carbon Stars. I — <i>Gravitational Contraction and Onset of Carbon Burning</i> —	Tadayuki Murai, Daiichiro Sugimoto, Reiun Hōshi and Chushiro Hayashi	619
$^6\text{Li}(p, 2p)^5\text{He}$ Reaction and Alpha-Deuteron Cluster Model for ^6Li	Sakae Saitō, Jun Hiura and Hajime Tanaka	635
Effects of the Degeneracy on the Bethe-Goldstone Type Equation for ^{18}O	Shōta Suekane	662
Effects of the s-State Pion-Nucleon Interaction on the Partial-Wave Nucleon-Nucleon Absorptions	S. Francaviglia	676
Complex Singular Potential Interpretation of Low Energy KN and $\bar{K}N$ Systems	Richard M. Spector and Ramesh Chand	682

Note on the Dynamics of the $K\pi\pi$ ResonancesYoshiko Oi Nakamura	690
X^0-η Mixing and Radiative Meson Decays	
..... Akira Kanazawa and Tetsuro Sakuma	696
A Phenomenological Model for π and K Meson Decays ..Kimiaki Konno	702
Weak Radiative Decays of Hyperons and Partially Conserved Tensor	
Current	
.....Masataka Hosoda and Kazuhiko Ozaki	711
$SU(6)$-Representation Mixing in Covariant Chiral $U(6)\otimes U(6)$ Scheme	
of Baryon-Meson Interactions	
..... Kiyomi Itabashi	717
Nonsense Channels and "Non-Regge" SingularitiesHaruo Fujisaki	742
CP-Violation in η, K^0 Decays and the $\Delta I=2$ Selection Rule	
..... Kozo Inaoka and Hideyuki Koyama	751
Classical Motion of Particles and the Physical-Region Singularity of	
the Feynman Integral	
.....Noboru Nakanishi	768
On the Mandelstam Symmetry in the S-Matrix TheoryMasakuni Ida	772
An Impact Parameter Representation of the Scattering Problem ..	
..... Toshimi Adachi and Tsuneyuki Kotani	785
On the Two-Body Bound State Problem of Dirac Particles ..Yoshio Koide	817
Limiting Process of Cutoff and Auxiliary Fields in Quantum Field	
Theory. I.	
..... Kan-ichi Yokoyama	830
Letters to the Editor :	
Triality and Freedom of Hadrons	S. Azuma 847
Remarks on the Bound State Problem of Dirac Particles in Connection with the	
Non-Relativistic Quark Model.....	M. Nagasaki 848
On the Normalization of Solid Harmonics for $U(3)$	T. Kayama 850
On the Clebsch-Gordan Coefficients for $SU(3)$	T. Kayama 851
Proton-Proton Bremsstrahlung at 52.3 MeV.....	
..... J. Sanada, M. Yamanouchi, Y. Tagishi, Y. Nojiri, K. Kondo,	
S. Kobayashi, K. Nagamine, N. Ryu, H. Hasai, M. Nishi, M. Seki and D. C. Worth	853
Remarks on "Semirelativistic Quark Model for Mesons"	M. Nagasaki 854
A Comment on the Radiation Spectra from Quasars	K. Takarada 856
The P and P' Regge Pole Parameters from Inverse Dispersion Relations	
..... O. Miyamura and F. Takagi	858
On the Form Factors of Radiative Decays of Charged Kaons	H. Namaizawa 860

No. 4 April

Theory of Collision-Induced Infrared Absorption in Compressed	
Gases. I—Collision-Induced Translational Absorption in Rare	
Gas Mixtures	
..Kenkichi Okada, Tomoyoshi Kajikawa and Tsunenobu Yamamoto	863
Ultrasonic Attenuation near the Magnetic Critical Point	
..... Kensuke Tani and Hazime Mori	876
The Critical Fluctuation of the Order Parameter in Type-II Super-	

conductors.....	Kazumi Maki	897
Cluster Expansion for Quantum Gases, III— <i>Pair Distribution Function of Degenerate Bose System</i> —		
.....Hiroaki Hara, Hiroshi Ichimura and Tohru Morita		907
On the Electronic State of Macromolecules, II	Hideo Fukutome	929
Dynamics of the Ising Model near the Transition Point ..	Ryuzo Abe	947
Thermal Instability in a Nuclear Burning Shell of Stars ..	Reiun Hōshi	957
Theory of the Excited-Core Nuclear Model.....	V. K. Thankappan	985
New Determination of the P and the P' Regge Pole Parameters..		
.....Osamu Miyamura and Fujio Takagi		1000
An Impact-Parameter Representation of Pion-Nucleon Scattering Amplitudes at High Energies	Reiji Kubo	1006
High Energy NN Scattering with Large Momentum Transfer and Chiral $SU(2) \times SU(2)$ Symmetry	Yasuo Hara	1020
Algebra of Current and the Nonrelativistic Quark Model.....		
.....Komajiro Niizeki		1025
On the Experimental Discovery of the Nonlocality in Microphenomena	Matsuo Sekine	1038
Green's Function of Bilocal Field Equations	Takeshi Shirafuji	1047
Letters to the Editor:		
On Nuclear Models and Excitation Energies.....	A. K. Dutta	1069
Soft Meson Approximation and the Decays of Tensor Mesons.....	K. Miura	1070
Relations between the Spectra of 2^+ and 2^- Mesons	C. Itoh	1072
Possible 27-plets in Baryon Resonances.....	Y. Oyanagi	1073
An Exact Form of First-Order Self-Energy in Random Lattice Problems ..	F. Yonezawa	1076
Quantum Fluctuation of Gravitational Field and Creation of Matter.....	N. Hokkyo	1078
Quantum Theory of Pressure Broadening in Plasma..	A. Tsuji, Y. Urabe and H. Narumi	1079
Remarks on the Simple Quark Model for Nonleptonic Hyperon Decays		
.....S. Miyake and A. Toda		1081
Masses of Bosons with Higher Spins and the Spectral Function Sum Rules....	S. Iwao	1083
On the Weak Axial Mean Square Radius of the Nucleon from Photoproduction Sum Rules.....	G. Ghika, E. Rădescu and M. Vişinescu	1085
Is There a Mass Quantum?.....	J. C. Aron	1086

Erratum

Exchange Current and Decays of Decuplet Baryons in the Quark Model (Vol. 39, p. 182)	T. Kobayashi and K. Konno	1089
--	---------------------------	------

No. 5 May

Stability of Non-Magnetic State in 3d Transition Metals		
.....Jiro Yamashita, Hiroko Namba and Setsuro Asano		1091
Cluster Expansion for Degenerate Bose Fluids.....	Tohru Morita	1100
Ordering in Certain Statistical Systems of Ising Spins ..	Huzio Nakano	1121

Dynamics of Critical Fluctuations. I	Kyozi Kawasaki	1133
Coarse-Grained Quantities in Aperiodic Systems. III — <i>Monte-Carlo</i>		
<i>Calculation of the Impurity Band States</i> —		
..... Kenkichi Okada and Hirotsugu Matsuda		1153
Collective Fluctuations of the Order Parameter in Superconducting		
Surface Sheath.....	Kazumi Maki	1165
Thermal Conductivity of a Heisenberg Chain	D. L. Huber	1170
Stability Condition of the Hartree-Fock States against Four-Body		
Correlations.....	Kenji Suzuki	1180
Absorption Correction in High Energy Photoproduction of π^+		
.....	Tadashi Yano	1193
K^+-p Elastic Scattering at 3.5 and 5 GeV/c		
.....	Shigeo Minami and Kazuo Shigeta	1209
A New Sum Rule for πN Scattering and the Regge Pole Model ..		
.....	Hikaru Sato	1219
The Vector Meson Dominant Model and the $K \rightarrow \pi e^+ e^-$ Decay		
.....	S. Y. Tsai	1223
Phenomenological Approach to Non-Leptonic Decays. I — <i>Scatter-</i>		
<i>ing-like Structure as a Background of Vector Pole Dominance in</i>		
<i>S-Waves, and a Problem of P-Waves</i> —		
..... Mitsuo Imoto and Katsuhiko Ohya		1233
Phenomenological Approach to Non-Leptonic Decays. II — Ω^-		
<i>Decays under Parameters Fit to Decays of Octet Baryons</i> —		
..... Katsuhiko Ohya, Mitsuo Imoto and Shoichiro Kawasaki		1268
On Nonleptonic Decays — <i>A Possible Scheme for $J^+ J$-Type Weak</i>		
<i>Interaction Picture</i> —		
Shin-ya Furui, Tetsuya Tsuchida, Kanji Fujii and Shoichiro Kawasaki		1278
Three Properties of Nonleptonic Hyperon Decays		
..... Azuma Toda and Akihiro Murayama		1289
Composite Model and Regge Pole .. Shigeru Machida and Toshihiro Yoshida		1304
Two-Dimensional Euclidean Group and the Partial-Wave Expan-		
sion. I	Tadashi Miyazaki	1319
All the Hadronic Contributions to the Anomalous Magnetic Moment		
of the Muon and the Lamb Shift in the Hydrogen Atom		
.....	Hidezumi Terazawa	1326
Another Convergent, Relativistic Model Theory of Interacting Par-		
ticles — <i>A Relativistic Version of a Modified Lee Model</i> —		
.....	Hideji Kita	1333
Letters to the Editor:		
Phenomenological Potential for $d-d$ Elastic Scattering.....	H. Itoh	1361
Gamma-Gamma Angular Correlations of the Radiations from the Decay of Hf^{175}		
.....	B. P. Singh, H. S. Dahiya and U. S. Pande	1363

Spin-Spin Correlation Function at the Transition Point of Itinerant Electron Ferromagnet	T. Izuyama	1365
A Decorated Ising Lattice with Three Transition Temperatures.....	I. Syozi	1367
Selfconsistent Method in Quantum Electrodynamics	H. Yamamoto	1369
The de Sitter Universe and Mach's Principle.....	A. Inomata	1370
On the Weak Interaction and the Structure of Sakaton	T. Hayashi, Y. Koide and S. Ogawa	1372

No. 6 June

Note on the Superconducting Dilute Alloy with Paramagnetic Impurities. I — <i>Basic Formulation and Some Application</i> — ..	Kiyoshi Kawamura	1375
On the Bound State of Conduction Electrons Coupled with a Localized Spin	Sadao Nakajima	1402
Singlet Ground State of a Localized Spin in Metals	Akio Yoshimori and Kei Yosida	1413
General Theorem for Interacting Many-Particle Systems	Setsuo Misawa	1426
Evolution of Carbon Stars. II — <i>Carbon Burning Phase</i> —	Daiichiro Sugimoto, Yoshiaki Yamamoto, Reiun Hōshi and Chushiro Hayashi	1432
Rapid Contraction of a Protostar to the Stage of Quasi-Hydrostatic Equilibrium. I — <i>The Case of One Solar Mass without Radiation Flow</i> —	Takenori Nakano, Noboru Ohya and Chushiro Hayashi	1448
Selfconsistent Treatment of Collective Vibrations in Terms of Boson Expansions	Bent Sørensen	1468
New Method of High Energy Jet Shower Analysis — <i>Relative Four-Momentum between Secondary Particles</i> —	Shun-ichi Hasegawa, Katsuaki Kasahara and Tōru Shibata	1487
Experimental Analyses of the $SU(3)$ Symmetry in High Energy Two-Body and Quasi-Two-Body Scattering	Kimio Fujimura, Tsunehiro Kobayashi and Ichiro Ohba	1501
Compton Scattering of Isovector Photons with Nucleons and Algebra of Fields	Masaaki Kato and Ken Kawarabayashi	1527
Mass Relations for 1^- and 1^+ Nonets Based on Weinberg's Sum Rules	Ken Kawarabayashi and Shinsaku Kitakado	1531
Large Angle Scattering in Quark Model	Yoshio Takada	1536
Nonleptonic Hyperon Decays Based on the Composite Scheme ..	Akihiro Murayama	1546
Radiative Corrections to Leptonic Decays of Hadrons	Koichi Nakamura	1554

A Comment on the p-n Mass Difference	
.....Yasuo Matsumoto and Taizo Muta	1565
A Generalized Lovelace Equation in the Relativistic Faddeev Formalism. II. ..	
Nobuhiko Mishima, Shinsho Oryu and Yasutaro Takahashi	1569
Multiple Poles in the Scattering Green's Function and the Light-like Limit of the Bethe-Salpeter Amplitude	
Noboru Nakanishi	1585
Letters to the Editor:	
Nonleptonic Hyperon Decays and the $U(4)$ Model	Y. Koide 1598
Proton-Nucleus Scattering at very High Energy....	H. Kanada, K. Sakai and M. Yasuno 1599
Absorption of Positive Pions at Low Energy by Deuteron	
..... Il-T. Cheon and A. Tohsaki	1601
Exponential Type Residue in Regge Pole Analysis of the Process $\pi^+p \rightarrow \pi^0 \Delta^{++}$	
..... T. Yoshida	1603
Symmetry Breaking in the $SU(3)$ Chiral Dynamics.....	T. Minamikawa 1605
Instability of Spheroidal Super-Heavy Nuclei....	K. Takahashi, I. Kajita and M. Yamada 1607
Author Index to Volume 39	1609
Subject Index to Volume 39	1615
Contents to Volume 39	i

CONTENTS OF THE NEXT ISSUE

Progress of Theoretical Physics

Vol. 40, No. 1 July 1968

Nuclear Magnetic Spin-Lattice Relaxation in Solid Ortho-Hydrogen below T_λ	Shigeo Homma
Dynamics of Critical Fluctuations. II	Kyozi Kawasaki
Diffuse Collective Mode in the Linear Magnetic Chain	Yoshiki Kuramoto
On the Green's Function in an Expanding Universe and Its Role in the Problem of Mach's Principle	Hidekazu Nariai
Four-Body Correlations in Light Nuclei — <i>The Interaction between a Four-Body Mode and a Single-Hole Mode</i> —	Jörg Eichler, Toshio Marumori and Kenjiro Takada
Hartree-Bogoliubov Theory with Projection Method	Naoki Onishi
Baryon Resonances and SU_3 Mixing. I — $N^*(1400)$ —	Francis Halzen and Michiji Konuma
Nonleptonic Hyperon Decays and Equal-Time Commutation Relations — <i>Comment on Kumar-Pati Theory</i> —	Masanobu Hirano, Kanji Fujii and Osamu Terazawa
Absorbing Hard Core and Regge Cuts	I. Kimel and Hironari Miyazawa
Cluster Model of Hadrons. II — <i>Mass Spectrum and Decay of Mesons</i> —	Shoichiro Otsuki, Shoji Sawada and Fumihiko Toyoda
Strange Spin Formalism for Hadrons	Kazuhisa Shima, Tsuneo Suzuki, Akizo Kobayashi and Hirofumi Senju
Photon Propagators in Quantum Electrodynamics	Kan-ichi Yokoyama
Duality between the Feynman Integral and a Perturbation Term of the Wightman Function	Masatsugu Minami and Noboru Nakanishi

Letters to the Editor:

On the Connection between Two Models of the Nambu Equation	S. P. Rosen
Saturation of Superconvergence Relations for Pseudo-Scalar Pseudo-Scalar Scattering	O. Miyamura and F. Takagi
Ferromagnetism of Electron Solid	T. Hamada, T. Ishizuka and Y. Nakamura
Low Energy Theorems for the Compton Scattering of the Isovector Photon from Spin 0 Systems in Chiral Dynamics	M. Hosoda and K. Ozaki
A Statistical Model of Ising Spin with Five Transition Points	S. Miyazima and I. Syozi
Use of Factorization in Constructing Superconvergent Sum Rule	V. P. Seth and B. K. Agarwal
Determination of the Coupling Constant $g_{NN\eta}$	S. Sasaki
Meson Structure and Spin-Orbit Splitting of Meson Mass	S. Otsuki

